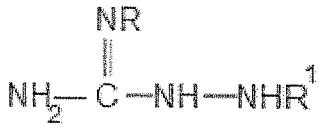
WHAT IS CLAIMED IS:

1. A diesel fuel for fuel injection comprising:

a major amount of middle distillate fuel having a sulfur content of 50 ppm by weight or less; and

a reaction product of (a) a hydrocarbyl substituted dicarboxylic acid, anhydride, or ester and (b) an amine compound or salt thereof of the formula



wherein R is selected from the group consisting of hydrogen and a hydrocarbyl group containing from about 1 to about 15 carbon atoms, and R^1 is selected from the group consisting of hydrogen and a hydrocarbyl group containing from about 1 to about 20 carbon atoms, wherein the reaction product contains less than one equivalent of an amino triazole group per molecule of reaction product, and wherein the reaction product is present in an amount of from 5 to 200 mg per kilogram of fuel composition which amount is sufficient to improve the performance of diesel direct and/or indirect fuel injectors.

2. The fuel of claim 1, wherein the reaction product is characterized by an FTIR spectrum having a peak intensity in a region of from about 1630 cm^{-1} to about 1645 cm^{-1} that ranges from about 5 to about 45% of peak intensities of other peaks in a region of from about 1500 cm^{-1} to about 1800 cm^{-1}.

3. The fuel of claim 1, wherein a molar ratio of (a) to (b) in the reaction product ranges from about 1:0.5 to about 1:1.5.

4. The fuel of claim 1, wherein the hydrocarbyl dicarboxylic acid, anhydride, or ester is chosen from hydrocarbyl substituted succinic anhydrides, hydrocarbyl substituted succinic acids, and esters of hydrocarbyl substituted succinic acids.

5. The fuel of claim 4, wherein the hydrocarbyl group of the hydrocarbyl dicarboxylic acid, anhydride, or ester has a number average molecular weight of from about 200 to about 3,000.

6. The fuel of claim 5, wherein the diesel fuel comprises a fuel for a direct fuel injection engine.

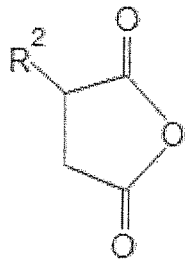
7. The fuel of claim 5, wherein the hydrocarbyl group of the hydrocarbyl dicarboxylic acid, anhydride, or ester comprises a polyisobutylene radical that is derived from high reactivity polyisobutenes having at least 60% or more terminal olefinic double bonds.

8. The fuel of claim 1, wherein the amine comprises an inorganic salt of guanidine.

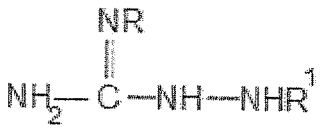
9. The fuel of claim 1, wherein the amine comprises a salt of aminoguanidine.

10. The fuel of claim 1, wherein the amine comprises aminoguanidine bicarbonate.

11. A method of improving the injector performance of a fuel injected diesel engine comprising operating the diesel engine on a fuel composition comprising a major amount of diesel fuel having a sulfur content of 50 ppm by weight or less and from 5 to 200 mg per kilogram of fuel composition~~a minor amount~~ of a reaction product derived from (a) a hydrocarbyl carbonyl compound of the formula



or an acid or ester thereof, wherein R^2 is a hydrocarbyl group having a number average molecular weight ranging from about 200 to about 3000 and (b) an amine compound or salt thereof of the formula



wherein R is selected from the group consisting of hydrogen and a hydrocarbyl group containing from about 1 to about 15 carbon atoms, and R^1 is selected from the group consisting of hydrogen and a hydrocarbyl group containing from about 1 to about 20 carbon atoms, wherein the reaction product is characterized by an FTIR spectrum having a peak intensity in a region of from about 1630 cm^{-1} to about 1645 cm^{-1} that ranges from about 5 to about 45% of peak intensities of other peak in a region of from about 1500 cm^{-1} to about 1800 cm^{-1} and the reaction product contains less than one equivalent of amino triazole group per molecule of reaction product.

12. The method of claim 11, wherein a molar ratio of (a) to (b) in the reaction product ranges from about 1:0.5 to about 1:1.5.

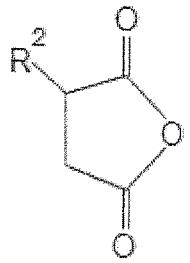
13. The method of claim 11, wherein R^2 is a polyisobutylene having a number average molecular weight of from about 200 to about 3,000.

14. The method of claim 11, wherein the fuel injected diesel engine comprises a direct fuel injected diesel engine.

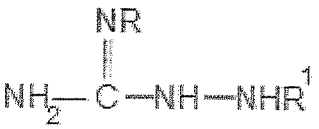
~~15. The method of claim 11, wherein the reaction product contains less than one equivalent of an amino triazole group per molecule of reaction product.~~

~~16~~15. The method of claim 11, wherein the amine is aminoguanidine bicarbonate.

~~17~~16. A method of cleaning fuel injectors of a fuel injected diesel engine comprising operating the diesel engine on a fuel composition comprising a major amount of diesel fuel having a sulfur content of 50 ppm by weight or less and from 5 to 200 mg per kilogram of fuel composition~~a minor amount~~ of a reaction product derived from (a) a hydrocarbyl carbonyl compound of the formula



or an acid or ester thereof wherein R^2 is a hydrocarbyl group having a number average molecular weight ranging from about 200 to about 3000 and (b) an amine compound or salt thereof of the formula



wherein R is selected from the group consisting of hydrogen and a hydrocarbyl group containing from about 1 to about 15 carbon atoms, and R^1 is selected from the group consisting of hydrogen and a hydrocarbyl group containing from about 1 to about 20 carbon atoms, wherein the reaction product contains less than one equivalent of an amino triazole group per molecule of reaction product.

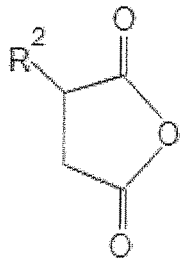
~~18~~17. The method of claim ~~17~~16, wherein R^2 is a polyolefin radical having a number average molecular weight of from about 200 to about 3,000.

~~19~~18. The method of claim ~~17~~16, wherein the fuel injected diesel engine is a direct fuel injected diesel engine.

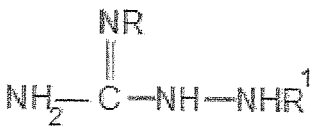
~~20~~19. The method of claim ~~17~~16, wherein a molar ratio of (a) to (b) in the reaction product ranges from about 1:0.5 to about 1:1.5.

~~21~~20. The method of claim ~~17~~16, wherein the amine is aminoguanidine bicarbonate.

~~22~~21. A fuel additive concentrate for addition to a low sulfur diesel fuel for improving the performance of fuel injectors for a diesel engine comprising a reaction product derived from (a) a hydrocarbyl carbonyl compound of the formula



or an acid or ester thereof wherein R^2 is a hydrocarbyl group having a number average molecular weight ranging from about 200 to about 3000 and (b) an amine compound or salt thereof of the formula



wherein R is selected from the group consisting of hydrogen and a hydrocarbyl group containing from about 1 to about 15 carbon atoms, and R^1 is selected from the group consisting of hydrogen and a hydrocarbyl group containing from about 1 to about 20 carbon atoms, wherein the reaction product is characterized by an FTIR spectrum having a peak intensity in a region of from about 1630 cm^{-1} to about 1645 cm^{-1} that ranges from about 5 to about 45% of peak intensities of other peaks in a region of from about 1500 cm^{-1} to about 1800 cm^{-1}, and wherein the reaction product contains less than one equivalent of an amino triazole group per molecule of reaction product, wherein the reaction product is effective in the low sulfur diesel fuel to improve the performance of the fuel injectors at a concentration of from 5 to 200 mg of reaction product per kilogram of fuel.

~~23~~22. The additive concentrate of claim ~~22~~21, wherein R^2 is a polyolefin radical having a number average molecular weight of from about 500 to about 1,300 daltons.

~~24~~23. The additive concentrate of claim ~~23~~22, wherein the polyolefin radical is a polyisobutylene radical.

~~25~~24. The additive concentrate of claim ~~24~~23, wherein the polyisobutylene radical is derived from high reactivity polyisobutenes having at least 60% or more terminal olefinic double bonds.

~~26~~25. The additive concentrate of claim ~~24~~23, wherein the amine comprises an inorganic salt of aminoguanidine.

~~27~~26. The additive concentrate of claim ~~22~~21, wherein the diesel engine comprises a direct fuel injected diesel engine.

~~28~~27. A diesel fuel having a sulfur content of 15 ppm by weight or less and an amount of additive concentrate of claim ~~22~~21 sufficient to provide from about 5 mg to about 200 mg of the reaction product per Kg of fuel.